SUMMARY OF TOTAL MAXIMUM DAILY LOAD FOR FECAL COLIFORM FOR THE PAJARO RIVER WATERSHED

PROPOSED SCHEDULE

- Draft Project Report: December 2007
- Central Coast Water Board Hearing: 2008

BACKGROUND

Clean Water Act 303(d) List

Four water bodies in the Pajaro River watershed, as shown in Figure 1, were placed on the Clean Water Act 303(d) list of impaired water bodies. These waters were "listed" due to exceedances of existing water quality standards for fecal coliform and include the following:

- Pajaro River
- San Benito River
- Llagas Creek
- Tequisquita Slough

Beneficial Uses

Water quality objectives are in place to protect beneficial uses of the surface waters. In the case of the Pajaro River Fecal Coliform TMDL, water contact recreation is the most sensitive beneficial.

Water Quality Standards and Indicators

Fecal coliform and *Escherichia coli* (*E. coli)* are used as indicator organisms for the presence of pathogenic organisms. Fecal coliform and *E. coli* are together referred to as indicator bacteria.

The Water Quality Control Plan of the Central Coast Region (Basin Plan) describes the following numeric water quality objectives to protect water contact recreation:

> *Fecal coliform concentration , based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100mL.*

The State Water Resources Control Board is currently developing a proposal for new water quality objectives using generic *E. coli*. The proposed *E. coli* objectives are to be applied statewide and reflect USEPA recommended criteria for the protection of water contact recreation. Several Regional Water Quality Control Boards in the state have already adopted the USEPA recommended

criteria for *E. coli*.

The USEPA proposed *E. coli* objective includes a geometric mean essentially stating:

The geometric mean density of E. coli shall not exceed 126 MPN/100mL.

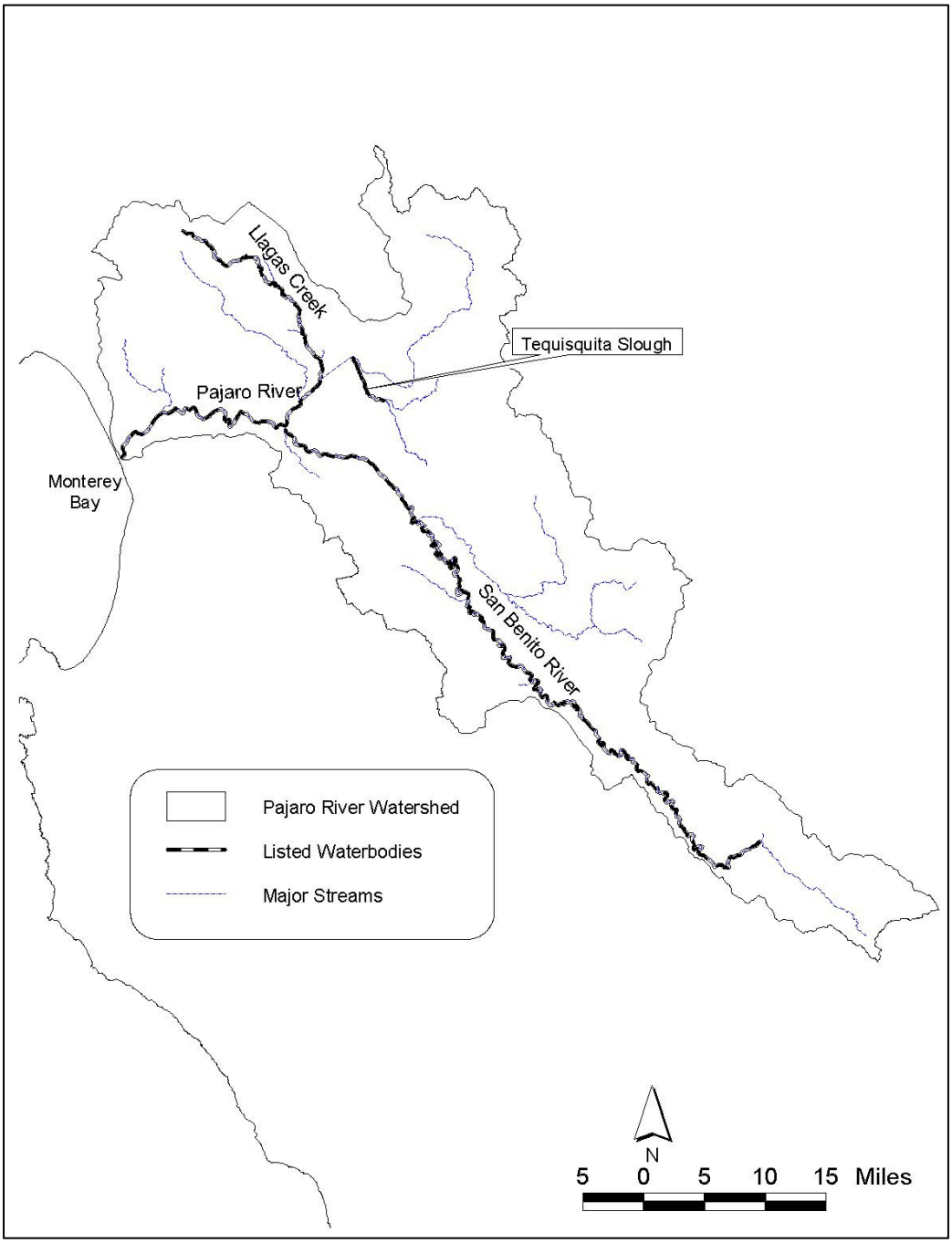

Figure 1 – Fecal coliform impaired waterbodies on the 303(d) list.

DATA SUMMARY

Data sources include:

- Central Coast Ambient Monitoring Program (CCAMP)
- Water Board staff monitoring activities
- Land Use information
- California Food Emergency Response Team (CalFERT) investigation data for *E. coli* strain O157:H7

The available water quality data includes concentration data of fecal coliform and *E. coli*. In addition, presence/absence data of the *E. coli* strain O157:H7 was obtained from the CalFERT investigation.

CCAMP DATA

The CCAMP conducted two periods of water quality monitoring within the Pajaro River watershed, from 1997-1998 and from 2005-2006. The first sampling period (1997-1998) included fecal coliform results only while the second sampling period (2005-2006) included both fecal coliform and *E. coli* results. Figure 2 shows the CCAMP monitoring locations and Table 1 describes monitoring site locations.

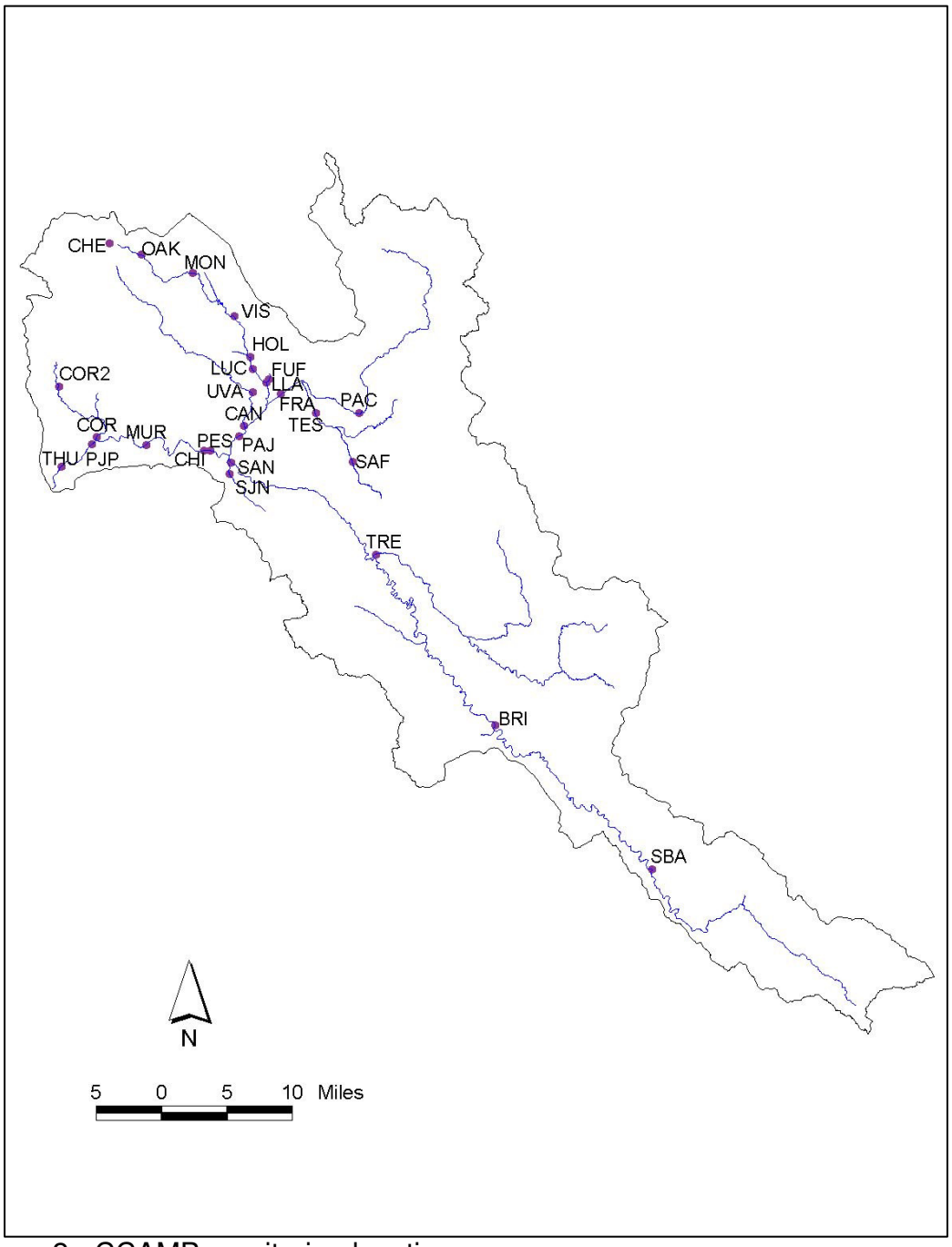

Figure 2 - CCAMP monitoring locations.

Table 1 - CCAMP Monitoring Sites.

Site ID	Site Name
BRI	305BRI-San Benito River @ Hwy 25 d/s Willow Creek
CAN	305CAN-Carnadero Creek @ Private Property Access
CHE	305CHE-Llagas Creek @ Chesbro Reservoir
CHI	305CHI-Pajaro River @ Chittenden Gap
COR	305COR-Salsipuedes Creek d/s of Corralitos Creek
COR2	305COR2-Upper Corralitos Creek
FRA	305FRA-Miller's Canal @ Frazier Lake Road
FUF	305FUF-Furlong Creek @ Fraiser Lake Road
HOL	305HOL-Llagas Creek @ Holsclaw and Leavesley Roads
HSA	305HSA-Harkins Slough @ San Andreas Road
LLA	305LLA-Llagas Creek @ Bloomfield Avenue
LUC	305LUC-Llagas Creek @ Luchessa Avenue/Southside Drive
MON	305MON-Llagas Creek @ Monterey Road
MUR	305MUR-Pajaro River @ Murphy's Crossing
OAK	305OAK-Llagas Creek @ Oak Glen Avenue
PAC	305PAC-Pacheco Creek @ San Felipe Road
PAJ	305PAJ-Pajaro River @ Betabel Road
PES	305PES-Pescadero Creek
PJP	305PJP-Pajaro River @ Main Street
SAF	305SAF-Santa Ana Creek @ Fallon Road
SAN	305SAN-San Benito @ Y Road
SBA	305SBA-San Benito River above unknown tributary
SJN	305SJN-San Juan Creek @ Anzar
TES	305TES-Tequisquita Slough
THU	305THU-Pajaro River @ Thurwachter Bridge
TRE	305TRE-Tres Pinos Creek
UVA	305UVA-Uvas Creek @ Bloomfield Avenue
VIS	305VIS-Llagas Creek @ Buena Vista Avenue

Table 2 (next page) shows summary data for each of the monitoring stations. The summary data show the number of data, maximum, and geometric mean for each sampling location. Note that the data in Table 2 is summary data only and is not meant to be compared with water quality objectives; the data is presented to give the reader a sense of relative concentrations of indicator bacteria in the project area.

Table 2 - Summary of CCAMP data (1997-1998 and 2005-2006).

SiteTag	FCOLI DATA COUNT	FCOLI MAX	FCOLI GEOMEAN	ECOLI DATA COUNT	ECOLI MAX	ECOLI GEOMEAN
305THU	59	54000	236	16	7500	80
305PJP	24	9000	188	15	11000	102
305MUR	25	50000	212	15	4600	81
305CHI	47	90000	239	15	13000	100
305PAJ	37	16000	266	15	2900	168
305FRA	25	24000	424	15	3000	159
305COR	27	5000	336	15	1600	170
305COR2	11	30000	177	11	13000	108
305PES	1	900	900	-	-	-
305SAN	26	50000	635	14	61000	473
305SJN	15	160001	902	15	130000	377
305TRE	17	160000	401	7	160000	1066
305BRI	15	90000	581	15	2000	255
305SBA	1	50000	50000	1	61000	61000
305CAN	16	2400	387	16	1300	132
305UVA	17	3000	169	10	170	72
305LLA	37	5000	403	15	930	172
305LUC	10	3000	586	-	-	-
305HOL	15	16000	291	7	1800	179
305VIS	3	900	316	-	-	-
305MON	10	300	125	-	-	-
305OAK	10	500	91	-	-	-
305TES	12	24000	4153	-	-	-
305SAF	1	24000	24000	1	20000	20000
305PAC	27	1400	272	15	1200	154
305FUF	15	90000	837	14	69000	655

Note: Dash (-) indicates that E. coli data was not collected for the site.

For most monitoring stations, fecal coliform and *E. coli* values are higher than values contained in the Basin Plan and as recommended *by* the USEPA.

WATER BOARD DATA

Water Board staff completed five rounds of sampling that collected *E. coli* samples every two weeks from November 30, 2006 to January 25, 2007. Most of the sites are the same as existing CCAMP sites because they can be easily accessed, however a few additional (non-CCAMP) sites were added. These additional sites are a storm drain on Pajaro River near Main Street in Pajaro (PJPSD), San Juan Creek above San Juan Bautista (SJB), Bird Creek near Hollister Hills Off-Highway State Vehicular Recreational Area (BCC), Pescadero Creek at Cienega Road (PSB), and a storm drain near Santa Ana Creek at Fallon Road (SAFSD). Table 3 is a summary of Water Board monitoring data for these sites.

Table 3 - Summary of Water Board data

SiteTag	ECOLI DATA COUNT	ECOLI GEOMEAN
305BCC	5	209.8
305BRI	5	98.0
305CHI	5	44.8
305FRA	5	109.3
305FUF	5	148.8
305HRL	5	41.2
305LLA	5	155.4
305MON	5	73.1
305MUR	5	25.9
305PAC	5	190.7
305PAJ	5	93.8
305PJP	5	100.1
305PJPSD	1	2419.6
305PSB	5	125.2
305SAF	5	171.4
305SAFSD	5	138.8
305SAN	5	370.1
305SBA	5	103.4
305SJB	5	182.4
305SJN	5	95.0
305TES	5	338.4
305THU	5	46.2
305TRE	5	66.4
305UVA	5	157.0

For most monitoring stations the *E. coli* geomean values are higher than levels recommended by USEPA.

Seasonality

Staff evaluated the CCAMP data based on wet season (November-April) and dry season (May-October). Wet season maximum fecal coliform values are generally greater for all stations with the exception of monitoring sites located along Uvas Creek, Llagas Creek, and Pachecho Creek. Wet season fecal coliform geomean values are greater for the five stations located along lower Pajaro River (305THU, 305PJP, 305MUR, 305CHI, and 305PAJ), however many of the remaining sites had a greater geomean value during the dry season.

Maximum *E. coli* wet season are consistently greater for all stations within the Pajaro River study area with the exception of the Furlong Creek at Bloomfied Avenue site (305FUF). Geomean *E. coli* values are greater in the wet season for the five stations located along lower Pajaro River (305THU, 305PJP, 305MUR, 305CHI, and 305PAJ), and for San Benito River at Y Road (305SAN), San Benito at Bridge (305BRI), and Lower Uvas Creek (305CAN). *E. coli* geomean values were higher in the dry season for four sites including Millers Canal at

Frazier Lake Road (305FRA), Llagas Creek at Bloomfield Avenue (305LLA), Pachecho Creek (305PAC), and Furlong Creek at Fallon Road (305FUF).

CalFERT INVESTIGATION

The FDA and California Department of Health Services, Food and Drug Branch (CDHS) jointly formed the California Food Emergency Response Team (CalFERT) to investigate the spinach outbreak of *E. coli* O157:H7 in the central coast region. CalFERT found *E. coli* O157:H7 in several environmental samples, however the investigation eventually focused on a San Benito county ranch located in Paicines, where the pulsed field gel electrophoresis (PFGE) pattern was indistinguishable from the *E. coli* O157:H7 outbreak strain found in the bagged spinach. The PFGE pattern was identified in San Benito River water, cattle feces, wild pig feces, and soil on the ranch. Land on the ranch was primarily utilized for cattle grazing with a small amount of land used for crop production. Investigators observed evidence of wild pig in and around the cattle pastures as well as in the row crop areas of the ranch. Investigators established that numerous wild pigs thrived alongside grazing cattle in the riparian habitat of the ranch.

Land Use

Land use areas in the watershed are categorized into:
1) grazing land
2) other lands (e.g., forested, government-owned, rural residential)
3) irrigated agricultural land
4) urbanized land (residential, commercial, industrial, airports, golf courses, etc.)
5) dry land farming

Grazing is the predominant land use within the Pajaro River watershed with an area of 62%, followed by the "other" land use category (e.g., forested, government-owned, rural residential) at 21% , irrigated agricultural lands (10%), urban 3%, and dry land farming 3%.

Staff evaluated the potential impact of land use activities upon fecal coliform and *E. coli* water quality conditions within the Pajaro river watershed and concluded that a direct relationship does not exist.

Preliminary Data Analysis Summary

- All listed waterbodies in the project area have values greater than the water quality objectives for indicator bacteria.
- Some waterbodies not currently listed also have values greater than the water quality objectives or USEPA recommended levels for indicator bacteria.
- The disease-causing strain of *E. coli* O157:H7 was found in San Benito River water samples near Paicines.
- Maximum and geomean values for fecal coliform and E. coli were consistently greater in the wet season for five monitoring stations along the lower Pajaro River.

- Maximum *E. coli* wet season values are consistently greater for all stations within the Pajaro River study area with exception to the Furlong Creek at Bloomfied Avenue site.
- *E. coli* geomean values were higher in the dry season for four sites including Millers Canal at Frazier Lake Road (305FRA), Llagas Creek at Bloomfield Avenue (305LLA), Pachecho Creek (305PAC), and Furlong Creek at Fallon Road (305FUF).
- Based on Water Board staff monitoring, the highest *E. coli* concentration was greater than the maximum quantification limit of 2419.6 MPN/100ml. This location was the storm drain located on the Pajaro River at Main Street (305PJPSD). The sample was obtained during a rain event on December 12, 2006 and verified with a duplicate sample.
- High levels of indicator bacteria were observed throughout all land use categories and a direct relationship between indicator bacteria levels and land use was not observed.

PRELIMINARY SOURCE ANALYSIS

Background (Natural) Sources of Indicator Bacteria

Staff observed numerous wild animals in the project area; all are potential sources of indicator bacteria to surface waters. The animals that are likely contributors include wild pigs, skunk, opossum, raccoon, deer, birds (including wild fowl), rodents, etc.

The CalFERT investigation found *E. coli* O157:H7 in wild pig feces that was indistinguishable from the spinach outbreak strain. Investigators observed evidence of wild pig in and around the cattle pastures as well as in the row crop areas of the ranch. Investigators established that numerous wild pigs thrived alongside grazing cattle in the riparian habitat of the ranch.

Livestock

Many areas in the Pajaro River watershed support grazing lands and livestock facilities. Staff observed livestock access to surface waters and channel banks in many portions of the watershed.

The CalFERT investigation found *E. coli* O157:H7 in cattle feces that was indistinguishable from the spinach outbreak strain. Land on the ranch was primarily utilized for cattle grazing with a small amount of land used for crop production.

In addition to large tracts of lands supporting grazing and livestock operations, some smaller parcels of land with single-family homes are used to raise farm animals, likely for personal use. Although the number of animals from the single family home operations may not be great, the combined affect could be impacting water quality.

Very few dairy operations still exist in the Pajaro River watershed. The few remaining dairies are located in southern Santa Clara county and northern San Benito county. Water Board staff has inspected these facilities and has issued requirements to eliminate the discharge of waste from one dairy operation that is located adjacent to Tequisquita Slough. Staff will ensure that these requirements are fulfilled so that no future discharge of bacteria occurs.

Sources from Urban Areas

The Central Coast Water Board has had DNA fingerprinting analysis performed from water samples drawn from urban watersheds (San Lorenzo and Watsonville Slough). Sources of indicator bacteria in urban channels typically include waste from wild animals, pets, and humans.

Staff observed numerous signs of waste from wild animals, pets, and humans along urban channels in the project area. Much of the animal and human waste in urban watersheds will reach urban channels either through overland flow or though storm water drains.

Based on Water Board staff sampling, high levels of indicator bacteria were detected in storm drain discharges at Pajaro River near Main Street in Pajaro (PJPSD) and at Santa Ana Creek at Fallon Road (SAFSD) during a storm event.

Homeless People

Staff observed homeless encampments and human feces in the Pajaro River watershed, primarily along the lower Pajaro River. The homeless encampments have been built along the banks of creek channels and under bridges. Estimating the contribution of indicator bacteria from homeless people to surface waters is difficult and likely variable. However, it is probable that the homeless population plays a role in the contribution from human sources.

Spills and Leaks from Sewer Systems

There are several regulated entities that collect and treat wastewater in the watershed area.

These regulated dischargers are required to report sewage spills to the Central Coast Water Board. Along with other information, the volume of the spill and whether the spill reached surface waters is reported. Spilled material is typically contained and disinfected as soon as possible.

Staff reviewed spill reports and interviewed the Water Board staff who oversee these regulated dischargers. Based on this information, sewage spills and leaks have occurred most often in areas that are served by the City of Hollister. It should be noted that the City of Hollister is in the process of upgrading their sewage treatment facilities to reduce the potential for future spills and leaks. Sewage spills and leaks from other regulated dischargers do not appear to be a source in the Pajaro River watershed.

Onsite Waste Disposal Systems
Many residential properties throughout the watershed have onsite septic systems. An unknown proportion of these reside near surface waters. Staff is proposing to further investigate onsite waste disposal systems to determine if this potential source contributes to excessive levels of bacteria indicators.

Irrigated Agricultural Lands
Staff reviewed water quality data and other information in an effort to determine whether irrigated agriculture is a source of indicator bacteria. Data and information suggest that irrigated agriculture is not a source of indicator bacteria causing exceedance of water quality objectives.

Growers in the project area are highly aware of food safety issues as their livelihood depends on providing a crop that is safe for consumers. As such, growers practice methods that minimize the potential of crop contamination. Staff observed conditions within the watershed and did not document land or field practices that would result in a controllable discharge of indicator bacteria to surface waters.

Staff is proposing that discharges from irrigated lands in the project area are not causing exceedance of water quality objectives related to indicator bacteria.

Summary of Preliminary Source Analysis
Table 4 outlines the source categories and probable source organisms of known or suspected sources of indicator bacteria in the project area.

Table 4 - Summary of preliminary source analysis; categories and source organisms.

Source Category	Source Organism(s)
Background (natural)	Examples include: wild pigs, skunk, opossum, birds (including fowl), and deer.
Livestock	Examples include: cattle, horses, goats, sheep, chickens.
Urban Sources	Dogs, cats, humans.
Homeless People	Humans

Staff is proposing to further investigate onsite waste disposal systems to determine if this potential source contributes to excessive levels of bacteria indicators. If further investigation provides evidence that onsite waste disposal systems are a source, then future Pajaro River Fecal Coliform TMDL documents will propose allocations and appropriate implementation actions.

PROPOSED NUMERIC TARGETS

Staff is proposing that the numeric targets for the TMDL be based on both the USEPA recommended concentration for *E. coli* as well as the current Basin Plan objective for fecal coliform.

The proposed generic *E. coli* numeric target is follows:

The geometric mean density of E. coli shall not exceed 126 MPN/100mL, based on a minimum of not less than five samples collected during any 30-day period.

The proposed fecal coliform numeric target is as follows:

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100mL.

TOTAL MAXIMUM DAILY LOAD (TMDL)

Staff is proposing TMDLs for the listed waterbodies and their tributaries.

The TMDLs are:

Discharges may not cause receiving water concentration of E. coli to exceed the following:

The geometric mean density of E. coli shall not exceed 126 MPN/100mL, based on a minimum of not less than five samples collected during any 30-day period.

Discharges may not cause receiving water concentration of fecal coliform to exceed the following:

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100mL.

ALLOCATIONS

Table 5 shows the allocations for each source category and corresponding responsible party. Note that responsible parties are not responsible for uncontrollable sources (background) of indicator bacteria.

Table 5 - Allocations

Responsible Party	Source Category	Allocation (fecal coliform and E. coli MPN/100mL)
Controllable Sources		
Operators or owners of grazing lands, livestock facilities, and farm animals	Livestock	▪ Equal to the TMDLs
Cities of Watsonville, Gilroy, Morgan Hill, and Hollister, and Counties of Santa Cruz, San Benito, Santa Clara and Monterey	Urban Sources	▪ Equal to the TMDLs
Land owners with homeless encampments	Homeless people	▪ Equal to the TMDLs
Uncontrollable Sources		
None	Natural (Background)	▪ Equal to the TMDLs

Staff is uncertain whether onsite waste disposal systems are a source that contributes to excessive levels of bacteria indicators. Staff is proposing to further investigate onsite waste disposal systems. If this investigation provides evidence that onsite waste disposal systems are a source, then future Pajaro River Fecal Coliform TMDL documents will propose allocations and/or implementation actions as appropriate.

IMPLEMENTATION AND MONITORING

The authority to require actions to implement and monitor the TMDL will likely be based on existing and proposed regulatory mechanisms. Water Board staff recommends the following actions be developed or modified as part of the TMDL implementation:

1. Owners of grazing lands, livestock facilities, and backyard livestock owners should implement management measures and reporting as part of waste discharge requirements (WDRs), waivers of WDRs, or prohibitions to comply with the states' Policy for the Implementation and Enforcement

of the Nonpoint Source Pollution Control Program (NPS Policy).

2. The Cities of Watsonville, Gilroy, Morgan Hill, and Hollister, and Counties of Santa Cruz, San Benito, Santa Clara and Monterey should specifically target reduction of indicator bacteria in their Storm Water Management Plans.
3. The Cities of Watsonville, Gilroy, Morgan Hill, and Hollister, the Counties of Santa Cruz, San Benito, Santa Clara and Monterey, and private landowners with homeless encampments should identify and implement management measures in an effort to eliminate human waste from entering surface waters.

Monitoring requirements will be described in the regulatory mechanisms regulating each source. Staff anticipates that the following may be required:

- Indicator bacteria monitoring of 303(d) listed water bodies.
  - E.g. from monitoring associated with permits, and/or regulatory mechanisms consistent with the NPS Policy.
- Monitoring of management measures aimed at achieving the allocations and TMDL.

Water Board staff will conduct triennial reviews to assess progress towards achieving the TMDL.

TIMELINE

Staff has not yet determined the amount of time necessary to achieve the TMDL.

CONTACT INFORMATION

Larry Harlan
895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401-7906
(805) 594-6195
lharlan@waterboards.ca.go